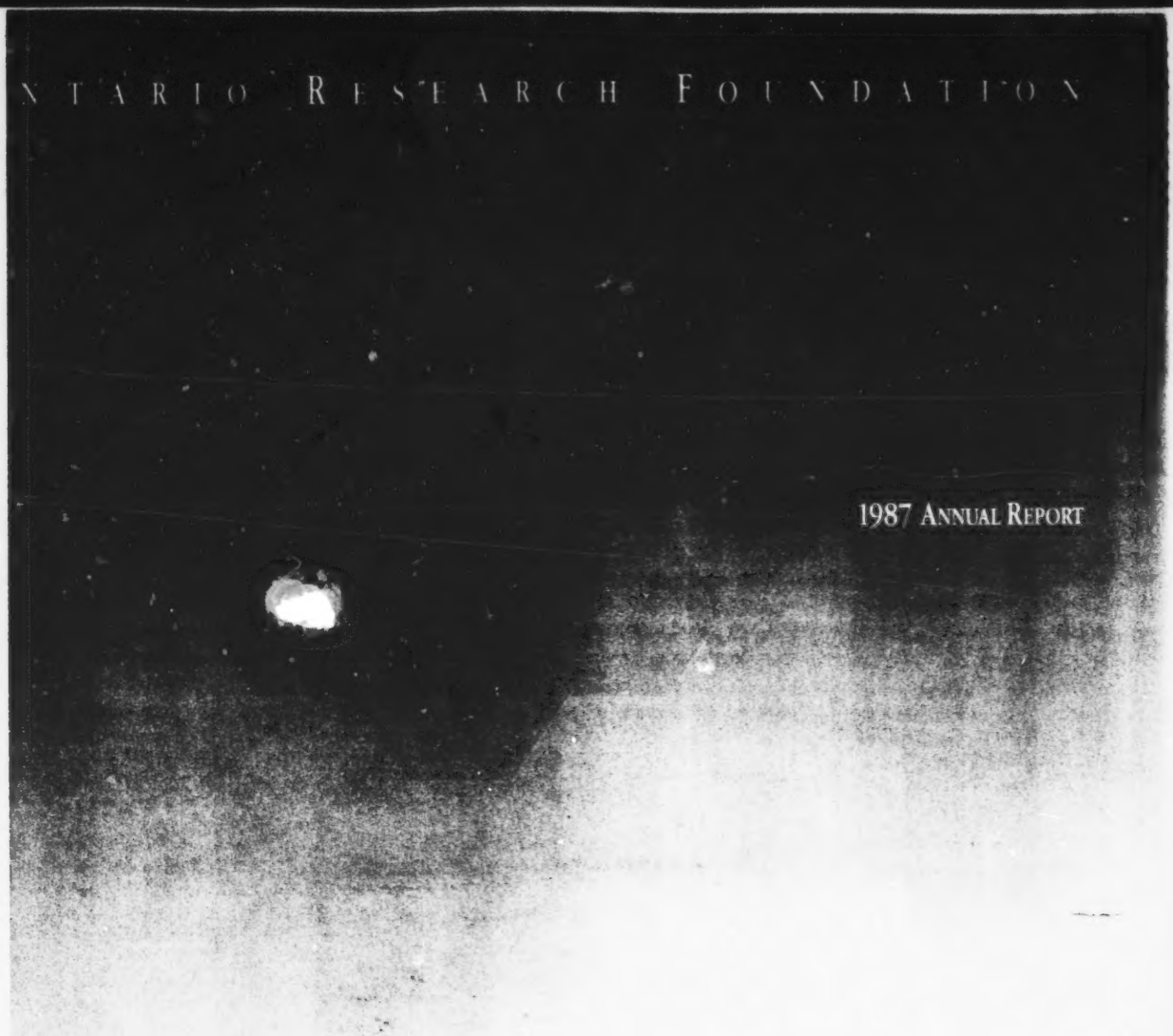
# ONTARIO RESEARCH FOUNDATION



## 1987 ANNUAL REPORT

*"Our mission is to provide pragmatic, results-oriented technology services that satisfy client needs for evaluating ideas, solving problems, and developing products and processes."*

W. Paul Mighall

*President*

# CORPORATE PROFILE

## CONTENTS


CHAIRMAN'S REPORT 1

PRESIDENT'S REPORT 2

REPORT ON OPERATIONS

INTRODUCTION 4

IDEA DEVELOPMENT

*New Flyer Industries Limited* 6
*Tamco Limited* 8
*COM DEV* 9

PROBLEM SOLVING

*Isolofoam Products Inc.* 10
*Amador Hydraulic Services Ltd.* 12
*Nevamar Corporation* 13

TESTING AND EVALUATION

*Walbar Canada Inc.* 14
*Magna International* 16
*Lambton Industrial Society* 17

FINANCIAL STATEMENTS AND NOTES 18

BOARD MEMBERS AND OFFICERS, 1987 22

SCIENTIFIC AND TECHNICAL PAPERS, 1987 24

ASSISTANCE TO OUTSIDE ORGANIZATIONS 25


ORF is Canadian industry's leading independent resource for problem solving and the development of ideas. More than 70 percent of 1987 professional service revenue of $20 million was generated by industrial contracts.

ORF's head office and primary technical facility is located in the Sheridan Park Research Community in Mississauga, Ontario; a second office/laboratory complex, located in Sarnia, serves southwestern Ontario.

ORF provides comprehensive resources in product engineering, industrial materials, energy, process engineering, technical information and environment to small, medium and large companies.

ORF was founded in 1928 as a joint initiative of the private sector and government to establish a leading edge technical resource for Canadian industry.

# CHAIRMAN'S REPORT

*John D. Houlding, Chairman of the Board*

If the events of 1987 allow one to draw any conclusion, it appears that rapid change will remain the normal situation for the foreseeable future.

In this environment, technology will be a vital tool, enabling managers to respond to the unexpected with the greatest degree of flexibility. This will be true in Canada's traditional industries, as it will be in those based on emerging technologies. For example, computers have already revolutionized every aspect of the auto industry — design, inventory management, manufacturing, marketing and even service.

ORF will continue to be a valuable asset to industry in this environment as long as it, too, evolves with the needs of industry. To meet this challenge, appropriate steps are being taken by ORF at the most senior levels, including the Board of Governors.

The broad perspective the Board members provide is being expanded and enhanced. In addition to the strong representation from traditional industries, we are looking forward to the addition of several highly-respected members from some of the top technology-based companies in the world, in lasers, telecommunications, data processing and aerospace.

At the same time, the new structure of the Board, which involves most members on one or more of five committees, enables much greater input from the Board. This will ensure that ORF's management team has access to the broadest perspective on key trends, and direction on likely industry needs over the long as well as the short term. This is vital for planning the investments in people and hardware needed to service the changing needs of industry.

Financial contributions from the Province of Ontario were invested in three technology areas of strategic importance to industry: computer aided engineering, advanced industrial materials and technical information systems. Investment in these areas will continue in 1988 with increased emphasis on plastic/composite materials as well as modern manufacturing systems.

ORF is responding to the changing industrial environment and I have confidence that it will become an even more useful resource to industry. In fact, the hectic pace of change and innovation will test all of us, but it is a challenge we welcome.

John D. Houlding
*Chairman*

# PRESIDENT'S REPORT

*W. Paul Midgball, President*

The mission of the Ontario Research Foundation is to provide pragmatic, results-oriented technology services that satisfy client needs for evaluating ideas, solving problems, and developing products and processes. The quality growth achieved in 1987 shows ORF is taking a lead role in helping our customers meet the high demands of today's fast changing world of technology.

## SOLID TECHNOLOGY GROWTH

We are proud of our 1987 track record in providing technology resources to the private sector. Our quantitative results prove that industry is increasingly recognizing ORF as a source of valuable bottom-line-building know-how.

During the year we served over 2,500 industrial clients, an increase of nine percent over 1986.

Professional services revenue accounted for 81 percent of total revenue and was also up nine percent from 1986.

Our output of technical papers was up more than 30 percent.

As well, the participation of our senior management and professional staff on the boards and committees of major industry groups, technical associations, etc. increased by 25 percent over 1986.

Financially, 1987 was an excellent year. All of our business centres started out strongly and maintained their momentum through the year. We ended 1987 with a small surplus that is being reinvested in much-needed capital equipment. In addition, we successfully completed a number of projects aimed at expanding the resources of ORF.

## ORGANIZATION AND TECHNOLOGY DEVELOPMENT

Like so many organizations today, ORF is managing significant internal cultural change in order to deal more effectively with the enormous technology evolution.

To anticipate effectively our clients' needs and improve the accessibility of our resources, we evaluated every aspect of the organization. For example, our success depends to a certain extent on how we are perceived. In 1987, detailed research and analysis of ORF's role, position and effectiveness in the eyes of current and prospective clients was carried out. This image review formed the basis for new proactive marketing and technology programs.

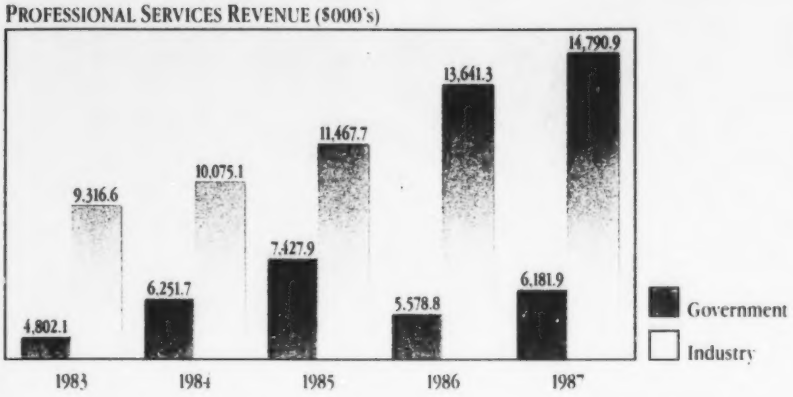
Few remember that ORF was created as a leading-edge technical resource for Ontario industry, so it is rededicating itself to this task. Our new marketing programs emphasize solving clients' problems rather than presenting shopping lists of our services.

We are now conducting ongoing consultations with clients to identify market demands and structure our capabilities to meet them. For example, while most of our clients are concentrated in Ontario, their markets are increasingly international in scope and require international linkages to access the best and most competitive solutions. Thus, strong relationships have been established with leading technology resource firms in Europe, the United States and the Far East.

These links also open the door to foreign contract and joint venture opportunities, in addition to ensuring a global perspective of the technology we apply to our clients' problems.

To help our clients in Ontario access our services better, we are expanding our client centre program. The client centres provide specific technologies to serve local industry needs and transfer a greater range of knowledge and services from

PROFESSIONAL SERVICES REVENUE ($000's)

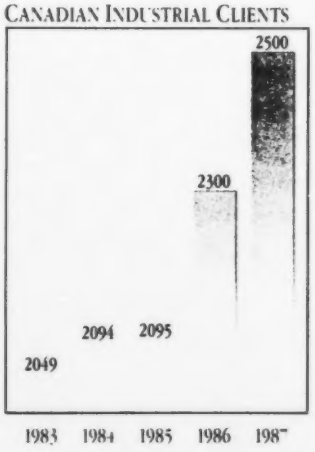



our Mississauga head office to other cities. The first centre was established in Sarnia in 1986, and work has started on our second centre which will be located in the Niagara region.

Another initiative that will make the organization even more responsive to today's fast-changing world is the consolidation of our divisions and the business centres within them. Our divisions have been reduced from three to two: Energy and Environmental Engineering, and Advanced Engineering and Manufacturing. The number of technology business centres within the divisions has also been consolidated from 16 to 10. Within Energy and Environmental Engineering are: Air Quality and Organic Analysis, Biotechnology and Chemical Engineering, Energy Systems, and Inorganic Materials. Within Advanced Engineering and Manufacturing are: Advanced Engine Technology, Computer Aided Engineering, Electronics Technology, Electro-Mechanical Products, Industrial Materials Technology, Product Testing and Evaluation.

This consolidation is founded on the belief that a facility such as ORF cannot be all things to all people. Experience has shown that concentrating on complementary technologies enables us to apply to client problems not only a great depth of knowledge, but a vital breadth of perspective on possible solutions. The result of this kind of multi-technology approach is a powerful synergy for solving the increasingly complex problems our clients face.

CANADIAN INDUSTRIAL CLIENTS




## OUTLOOK

Many technologies will be critical for fast-growth companies to progress in the future. In addition to the areas outlined above, special emphasis will be placed on the following complementary technologies:

- polymers and polymer composites, e.g. plastics
- modern manufacturing systems, e.g. automation
- technology information systems, e.g. software development

We plan to establish leadership capability in these areas, and turn our vision of a modern, dynamic and internationally-linked organization into a reality. For example, as a start to building a modern manufacturing systems capability, we recently formed an electronics group that encompasses chip design.

In 198~, the guidance and support provided by our Board of Governors increased as new Board committees met frequently on vital subjects. We are greatly indebted to these outstanding volunteers.

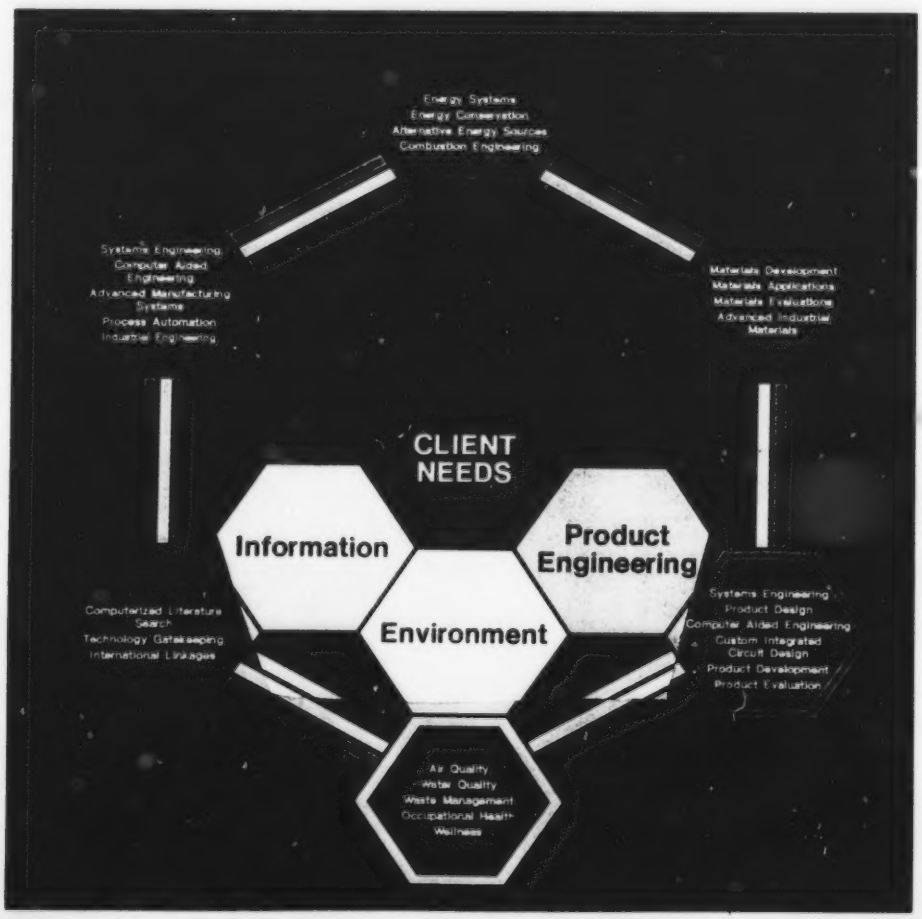
A very large part of our growth and financial success in 198~ is to the credit of our employees. Meeting client priorities while adapting to new organizational goals and objectives is extremely challenging and demands sustained high levels of flexibility, initiative and drive. This is what happened in 198~. We are all proud of this accomplishment and look forward to the challenges of managing further changes as dictated by a swiftly changing world of technology.

Finally, we are deeply grateful to those companies with the vision and courage to try out new ideas — these are our clients. You will read about a few of them in the following Report on Operations.

W. Paul Midghall

W. Paul Midghall
*President*

In product development or process problem solving, large companies or small have the same needs: solutions that are cost-effective. It's a tough challenge. The information explosion has created more potential solutions but competitive pressures leave little time for the developmental thinking that leads to long-term improvements in bottom-line performance. In this environment, the companies that make best use of precious human and financial resources will be the winners.

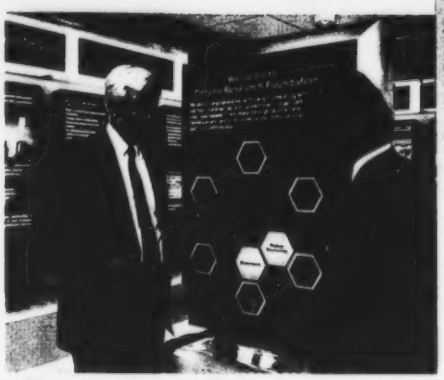



Some companies have great success creating and operating in-house an idea development and problem-solving resource; others rely exclusively on know-how provided on a contract basis. Still others have succeeded with input from both sources. But in all cases, effective idea development and problem-solving groups must have at least the following capabilities: proven know-how, responsiveness, sense of team spirit, efficient reporting, and continuity.

## Proven Know-How

Depth of expertise in a specific discipline is even more effective when a team of experts with complementary knowledge works together. There is a critical mass of talent that accelerates the process of evaluating the many potential solutions available and shortlisting workable ideas for further development.

***By developing complementary areas of expertise (outer ring) in six essential problem solving and idea development needs (inner ring), ORF creates a synergy of ideas and solutions that produces big paybacks for clients.***



*Paul Midgball shows a visiting businessman the new visitor centre.*

## Responsiveness

When the execution phase begins, know-how should translate into the appropriate response. For line operations, time is critical and affects all other areas of planning and results. Product development time lines are sometimes less urgent — in fact, a good idea may be ruined by expecting results too quickly. Thus, the synergy created by a talented team of experts working in complementary disciplines is what produces the best responses to client needs.

## Team Spirit

Even if the technical resource people are outside your organization, they should make you feel like they are an integral part of your team. Confidentiality is always a critical factor and team players make this a top priority.

## Efficient Reporting

It may seem obvious, but when the work is finished the results should be presented in clearly understandable terms and should answer the initial questions set for the project. Often development work turns up new opportunities, but the spin-offs should not overshadow the answer to the initial questions.

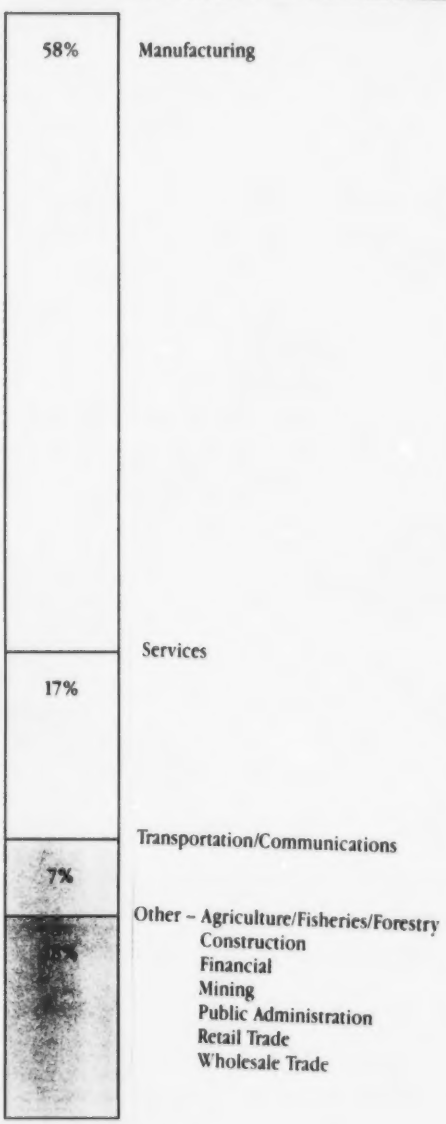
## Continuity

Ongoing revisions and modifications are inherent in every process and are also a fact of life in new product development, especially when dealing with outside contractors. You need an organization that can go the distance with a project, sometimes over several years of on-again, off-again effort.

We believe that this combination of skills is essential to effectively service the needs of our clients. It's an inherent strength of ORF that results from 59 years of service to Canadian industry. Delivering these results has helped us raise industrial revenue to 71 percent of our total billings and increase the profitability of our clients. But in today's fast-paced world, one does not succeed by standing still. Therefore we have made a commitment to constant improvement in our performance in all of these areas.

In the following case studies, some of our clients will tell you in their own words how we performed in these areas.

## Industrial Client Billings by Sector



# IDEA DEVELOPMENT

## New Flyer Industries Limited

In the face of an increasingly competitive marketplace brought about by production over-capacity in North America, bus manufacturers have to attain new levels of product quality assurance — and still make a profit.

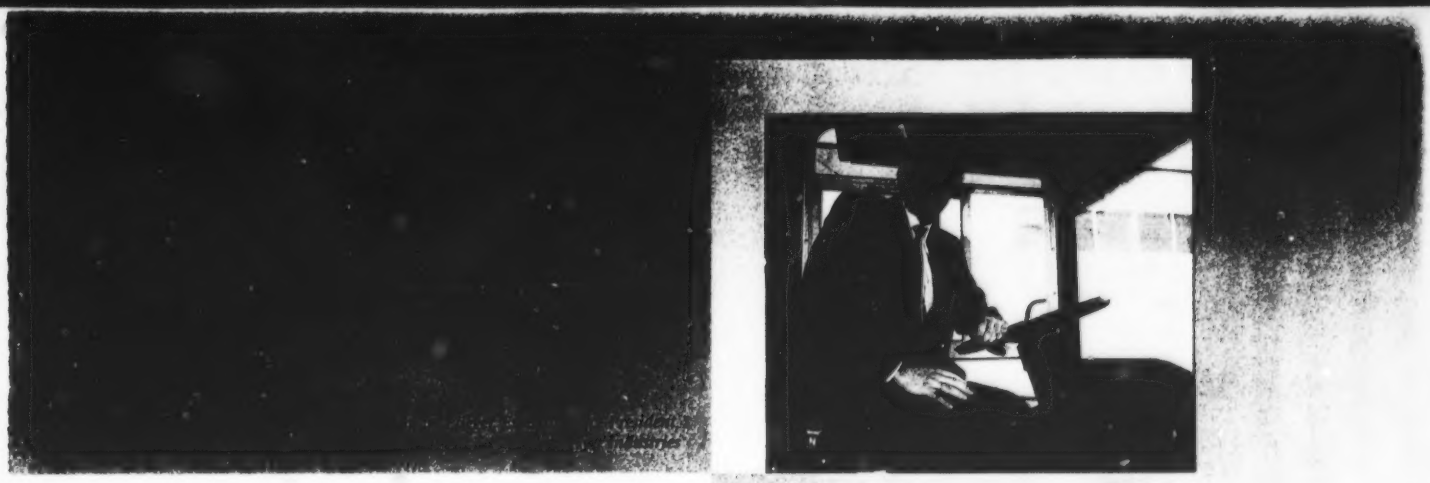
In addition, market forces demanding product quality assurance evaluation, especially with regard to durability qualification, are obliging manufacturers in the relatively low-volume bus industry to use the same computer aided engineering (CAE) techniques that have been commonplace in the high volume automotive market for a number of years.

For instance, when the den Oudsten Bus Company of Holland bought Flyer Industries Ltd. of Winnipeg in 1986, renaming it New Flyer Industries Limited, management of the parent company wanted to use CAE in the design and qualification of their new bus products. They went to ORF.

"We didn't just want to model the bus on the computer," said Anton Plieger, Executive Vice-President of New Flyer, "we wanted to integrate the computer modelling with beta testing. ORF has the most experience in these areas of any facility in North America."

Throughout the course of the project the staff of ORF's CAE Centre essentially worked as an extension of the New Flyer in-house design group, applying an array of computer based analytical and experimental resources coupled with extensive past experience.

*ORF's computer aided engineering service is helping a multinational bus manufacturer, New Flyer Industries.*



A key step in the process was to determine allowable design stresses, to be used in conjunction with a mathematical model of the bus, which were compatible with the achievement of design life in a specific operating environment. These design stresses had to accommodate the effects of bus maneuvering, passenger load, road surface and dynamic variations that would occur over the expected life of the bus.

Making extensive use of color-coded computer graphic output to communicate results, design objectives were achieved.

Road operating tests of a well-qualified prototype represented the final step in the process and consisted of driving the instrumented bus over a carefully designed "duty cycle" of limited length but representative of the anticipated operating environment. This could then be projected over the design life of the bus.

## *Tamco Limited*

Maintaining long-term profitability in the auto parts industry means innovative development of production techniques that accelerate throughput by reducing material and labor costs, while at the same time improving quality of the parts manufactured.

Tamco, a medium-sized manufacturer located in Windsor, is facing a problem with the heavy duty truck gearshift levers they manufacture that are used in truck tractors manufactured in North America. The problem is that the functional end of the lever which actuates and controls the transmission must be heat treated for case hardening to provide the wear and strength qualities required. At the same time, the upper shaft of the lever must remain pliable so that various bends and offsets can be formed in the upper handle portion to suit the requirements of the individual truck tractors, where many of the bends must be formed immediately above the functional end which has been heat treated. If the gearshift lever is heat treated all over, cracks will appear in the surface of the shaft portion where the bends must be made and these cracks could lead to failure. Thus there is the requirement for selective heat treating in specific areas which would not affect the balance of the lever.

In Tamco's never-ending search for product improvement, the thought was that laser case hardening might give the gearshift levers a competitive edge. Tamco found that the North American sources for laser heat treating were enthusiastic in the beginning, but after they researched the problem, they found they could be of no help. Tamco turned to ORF and did find some success.

"I read in a paper by an MIT professor about how low carbon steel could be surface hardened in selective areas without introducing carbon," said Bob Elliott, Plant Manager. "It sounded ideal for us because all of our product line is fabricated out of low carbon steel."

In ORF's Industrial Materials Technology Centre, a high power laser was used and a variety of heat treating environments were tested. ORF was able to obtain the surface hardness required by Tamco's and their customer's specifications, without affecting the delicate functional end of the lever. Elliot is now approaching Mitsubishi with this new information to see if they can provide a suitable laser.

"ORF *was able to reproduce the results that were predicted by the MIT report. It creates the possibility of significantly expanding the sales opportunities based on our existing materials know-how.*"

Robert Elliott

*ORF proved that laser hardening will dramatically improve gearshift lever quality and cut processing time.*

## *COM DEV*

In the highly competitive commercial telecommunications satellite industry, Canadian companies maintain their world leadership by aggressively exploring the limits of technology.

COM DEV is a leading manufacturer of microwave subsystems for commercial and military telecommunications. COM DEV components ride on over 70 percent of all commercial communications satellites. The company was looking for a materials innovation in magnetic ceramics that would improve the performance of its microwave and millimeter wave communications equipment. COM DEV talked to ORF's scientists because of their knowledge of advanced materials, especially fine ceramics.

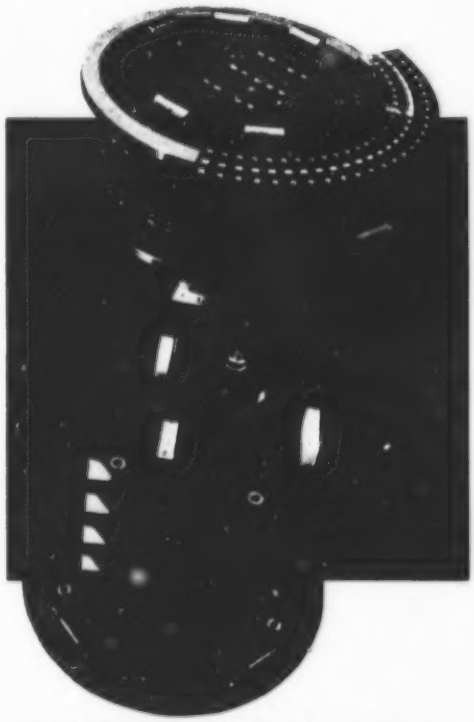
A joint COM DEV/ORF approach to the National Research Council gained funding to investigate techniques for manufacturing a new generation of novel supermagnetic ceramics. These materials have the potential of significant performance enhancement of future microwave and millimeter wave communications equipment. An added benefit of this material is the substantial savings in mass and volume by avoiding the need for heavy magnets used in current equipment. For satellite hardware, this implies significant savings in cost.

Market research conducted by ORF as part of the NRC project indicates that the materials know-how resulting from this work has substantial market potential for ground-based applications such as high-efficiency electric motors and generators, bubble memories for computers and radar-absorbing materials for national defence purposes.

Initial ground-based evaluations will be conducted in 1988, with trials in 1989 in NASA's zero-gravity simulator, an airplane known as the "Weightless Wonder." The plane produces about 30 seconds of microgravity when it flies a parabola-shaped loop.

*"Magnetic ceramics could add significantly to the salability of our products. When approaching NRC for funding on research into magnetic ceramics, COM DEV benefitted from ORF's reputation in fine ceramics R&D. It's a win-win situation for us."*

Doug McDonald



*New ceramics being developed by ORF will greatly improve the cost/benefit performance of satellite electronic systems.*

## Isolofoam Products Inc.

In the competitive home construction products industry, builders demand products that will reduce materials loss, cut construction time and improve performance of the finished house.

Isolofoam Products Inc. is a rapidly-growing Quebec-based manufacturer of expanded molded polystyrene insulation products. It had an idea for a revolutionary polystyrene insulation product that would also increase corporate visibility on construction sites. When certain development problems arose, their engineering consultant suggested a call to ORF for help.

"When you build a house there is a lot of technology in its exterior walls you don't see," said Mr. Germain Vachon, President of Isolofoam. "Once you get past the drywall, outward, there is an air/vapor retarder, then there is the insulation and then there is a second layer, called an air/moisture membrane, that lets water vapor from the inside out but keeps moisture from penetrating inward. Then there is siding."

Each layer requires a separate construction step. Mr. Vachon's idea was to combine the insulation with the outside air/moisture membrane. "The old way is to get big rolls of this barrier material and wrap them around the house. It's okay if you're working on the ground floor but on the second floor level you may need a ladder and it may be difficult to handle."

*ORF's expertise helped develop a novel time-saving, lower-cost home insulation product for Isolofoam.*

*Germain Vachon, President, Isolofoam Products Inc.*

Mr. Vachon had an idea to laminate the air/moisture membrane to the insulation in a way that would not interfere with the performance of either component. Then, the rigid polystyrene insulation and the membrane could go on in a single step. It would also create an advertising billboard. The company's name could be displayed on the membrane but not on the polystyrene insulation whose surface does not lend itself to very effective imprinting with inks.

ORF's Adhesives Laboratory experimented with several adhesives and application techniques and found a combination that looked promising. Some laminated polystyrene samples were prepared and run through ORF's Building Performance Centre where a 41 percent thermal leakage reduction was measured through the panel, without impairing the water vapor transmission performance of the air/moisture membrane or the expanded polystyrene insulation.

Patents are pending in both the U.S. and Canada.

## *Amador* Hydraulic Services Ltd.

Growth into larger markets is essential for small Canadian manufacturers but the time and cost involved in product re-engineering can seem insurmountable obstacles.

ORF helped Amador Hydraulic, a small manufacturer of mobile hydraulic lift platforms, overcome these problems with the aid of sophisticated finite element modelling on ORF's computer aided engineering (CAE) workstation.

"U.S. regulations demand an insulating insert in the lower boom arm to protect work crews from electrical shock," said Joe Amador, President of the company. "We had to be careful to keep weight down, too, because road loading rules can mean a stiff penalty is tacked onto your vehicle if it is overweight."

The results Amador got showed the benefits of advanced technology when it is appropriately applied to traditional manufacturing. ORF's CAE Centre took Amador's first cut blueprint and modelled it in the computer. "It was very detailed — every weld, every bolt and every bolt hole," said Amador.

The arm was then run through a worst-case load scenario on the computer. "I didn't have to read through stacks of paper to see where changes were needed," said Amador. "It was all so easy to see — each part is in a different color and the high stress points really stand out."

With this knowledge the arm design was revised by Amador. Once again the arm was modelled on the computer and run through a simulated worst-case load. This time it passed with flying colors.

*"ORF staff worked through Christmas helping us meet our contract deadline and opening up the U.S. market for us. We couldn't expand in Canada because the market here is just about saturated. We expect to sell five units a year at $250,000 each over the next five years."*

*ORF helped a small Canadian company successfully enter the giant U.S. market for "cherry pickers".*

## *Nevamar Corporation*

Sustaining a first-class product research development capability is a tough challenge even for medium-sized companies. Nevamar, a laminated plastics manufacturer, solved the problem by calling on ORF.

Nevamar Corporation employs 1,100, over half at its plant near Baltimore, Maryland. It sells products in the architectural interior design market, and the luxury end of the home building industry. Nevamar's competition includes several multinationals, each with large research and development staffs.

In addition to testing and evaluation work, ORF is deeply involved in product development at Nevamar. "They have such a range of experts," says Herb Scher, Senior Vice-President and Technical Director of Nevamar, "that they can come up with some really innovative ways to attack a problem. These are typically sound practical ideas that work.

"We really like the way they'll jump on a plane and be down the next day if we call with a problem. It's as if their expert is on our own staff, working to improve our process and materials formulation, develop test methods and conduct the tests.

"They are probably the most practical and results-oriented R&D lab we've ever dealt with in North America. ORF reports are always concise and answer the questions we ask."

"ORF *has been particularly helpful with scientific fundamentals. They are big enough to have the range of talent to effectively solve our problems, yet small enough to be responsive and flexible and take our input and give us the specific answers we need.*"

HI Scher

***ORF helps Maryland-based Nevamar compete against the giants of the architectural furnishings market.***

# TESTING AND EVALUATION

## Walbar Canada Inc.

Qualifying the integrity of the raw materials that go into super alloy parts used in the aerospace industry presents some unique challenges — but for parts suppliers it is imperative to achieve the requisite high-quality levels.

That was the situation that faced Walbar Canada Inc., a manufacturer of high-quality jet engine parts for customers in Europe and the U.S.

"Until recently the engine manufacturers did these tests," said John Anderson, Director of Quality Assurance, "but now we are responsible for the qualification of the raw materials and the finished parts."

The task is imposing. The raw materials are expensive so parts manufacturers tend to piece together smaller lots where they can be found at favorable prices, to meet larger orders. Each small lot must be tested, and there is a lot of testing to be done: chemical analysis, physical tests, metallographic evaluation and stress and creep rupture tests.

Walbar needed a guaranteed average turnaround time, plus a report distilling all the data from several hundred hours of testing down to a concise two pages.

*Bill Fossen (left) of ORF and John Anderson of Walbar examine jet engine parts material.*

*John Anderson, Director, Quality Assurance, Walbar Canada Inc.*

The Metals Technology Centre quarterbacks the work within ORF, distributing tasks to various labs.

After initial discussions late in the fourth quarter of 1986, ORF quickly geared up to handle the work in early 1987. ORF has maintained service levels for existing clients despite the heavy work load resulting from the high volume of work for Walbar.

## *Magna International*

In just a few years, the auto parts industry has been transformed. Not long ago, auto assemblers did all the testing of suppliers' parts; if the parts passed the tests, the company became an approved supplier. Today parts companies must provide full metallurgical and dynamometer tests validating the performance of their products. Providing these test results is essential to stay in business — let alone make a profit.

Magna International, Canada's largest auto parts company, lacked suitable testing and evaluation facilities for validating a timing chain they were developing for a major North American auto maker. So, they came to ORF for help.

"The decision to use ORF was simple," said Gary MacFarlane, Director Market Development. "They had a dyno and we didn't. They also had the metallurgical testing facilities for the initial fatigue testing."

First, ORF's Metals Technology Centre conducted a series of fatigue tests that indicated the basic design of the chains was sound. Then the Advanced Engine Technology Centre ran a series of five consecutive 200-hour test cycles for the chains in ORF's engine test cells.

*"We have used ORF before and they were our first choice for this project. In Canada, there isn't a more comprehensive test and evaluation centre. We will continue using ORF until we can justify doing this work ourselves. And even then we will continue using ORF for our overflow."*

***ORF tests enable Magna International to assure timing chain performance and durability.***

## *Lambton Industrial Society*

Industries that use and produce potentially toxic chemicals are finding that proactive initiatives to build public confidence about environmental safety are essential for long-term profitability.

When potable water is involved, continuous quality sampling with real-time analysis is optimum because it provides confidence that environmental regulations are being met at all times. Unfortunately, the complexity of the procedure and instrumentation for detecting low concentrations of substances in rivers and lakes have, until last year, made continuous water monitoring virtually impossible.

When ORF was approached by Ron Denning, General Manager of Lambton Industrial Society (LIS), to design a system for continuous water monitoring, it was obvious that automation would be essential. In manual operation, continuous monitoring requires two skilled technicians and a scientist to keep the instruments running and interpret the results. Reducing human involvement was essential to a cost-effective system.

An added challenge was adapting the system components from effluent monitoring, where the instruments are typically used for detecting one substance in parts per million concentrations, to monitoring six substances at much lower concentrations.

The system is elegantly efficient. Every hour, 10 miles downstream from Sarnia, a sample of St. Clair River water is automatically taken and run through an automated gas chromatograph. Within 45 minutes the tests are completed and results travel via modem and telephone lines to the LIS/ORF computer in Sarnia. The automation of the remote testing station has reduced costs by about two-thirds.

All LIS member companies can access the information on a real-time basis and are able to stay aware of day-to-day conditions in the river downstream of the plants. This provides for backup detection of the target substance should on-site testing fail to detect the particular substance. In 1987, the prototype system confirmed several spills which had been reported to the Ontario Ministry of the Environment.

*"We get comprehensive real-time data updated 168 times a week. We know of nothing else like it in North America, not even on the Niagara River. The system proved itself in 1987 and ORF will be adding several enhancements for us in 1988."*

Ron Denning

*North America's first continuous water quality monitoring system was developed by ORF for Lambton Industrial Society.*

# FINANCIAL STATEMENTS

## ONTARIO RESEARCH FOUNDATION

(Operating under the Research Foundation Act 1944)

### AUDITORS' REPORT

*To the Board of Governors of Ontario Research Foundation:*

We have examined the consolidated balance sheet of Ontario Research Foundation as at December 31, 1987 and the consolidated statements of income and retained earnings, fixed asset contributions and cash flows for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion these consolidated financial statements present fairly the financial position of Ontario Research Foundation as at December 31, 1987 and the results of its operations and the changes in its financial position for the year then ended in accordance with generally accepted accounting principles applied, except for the change in the method of accounting for pension plans as explained in note 2 to the consolidated financial statements, on a basis consistent with that of the preceding year.

The financial statements of the preceding year were examined by other Chartered Accountants.

Hamilton, Canada
February 8, 1988

**Clarkson Gordon**
Chartered Accountants

### CONSOLIDATED BALANCE SHEET

as at December 31, 1987
(with comparative figures for 1986) (5000's)

| | 1987 | 1986 |
|---|---|---|
| **ASSETS** | | |
| Current Assets | | |
| Cash and short-term deposits | $ 403 | $ 5 |
| Accounts receivable | 4,875 | 4,365 |
| Prepaid expenses (note 2) | 886 | 535 |
| | 6,164 | 4,905 |
| Investments (note 3) | 2,513 | 2,249 |
| Fixed Assets (note 4) | 12,000 | 12,678 |
| | $20,677 | $19,832 |
| **LIABILITIES** | | |
| Current Liabilities | | |
| Bank indebtedness | $ | $ 74 |
| Accounts payable and accrued liabilities | 1,970 | 1,342 |
| Amounts received in advance for research and other projects | 234 | 200 |
| | 2,204 | 1,616 |
| **CAPITAL** (note 5) | | |
| Capital contributions | 3,363 | 3,363 |
| Fixed asset contributions | 5,231 | 5,569 |
| Retained earnings for acquisition of equipment and facilities | 9,879 | 9,284 |
| | 18,473 | 18,216 |
| | $20,677 | $19,832 |

Approved on behalf of the Board of Governors

V. German E. Parliament

See accompanying notes to the consolidated financial statements.

## Consolidated Statement of Income and Retained Earnings

for the year ended December 31, 1987
(with comparative figures for 1986) ($000's)

| | 1987 | 1986 |
|---|---|---|
| **Revenue** | | |
| Professional services | $20,973 | $19,220 |
| Contributions from the Province of Ontario (note 6) | 3,700 | 3,700 |
| Investment income | 347 | 474 |
| Royalty and other income | 832 | 739 |
| | 25,852 | 24,133 |
| **Expense** | | |
| Salaries and benefits | 13,769 | 13,805 |
| Other costs of research | 7,589 | 6,943 |
| Depreciation expense less transfer from fixed asset contributions of $1,014 (1986 $1,097) | 1,773 | 1,918 |
| General | 2,126 | 1,477 |
| | 25,257 | 24,143 |
| Income (loss) for the year (note 2) | 595 | (10) |
| Retained earnings, beginning of year (note 5(C)) | 9,284 | 9,294 |
| Retained earnings, end of year, for acquisition of equipment and facilities | $ 9,879 | $ 9,284 |

## Consolidated Statement of Fixed Asset Contributions

for the year ended December 31, 1987
(with comparative figures for 1986) ($000's)

| | 1987 | 1986 |
|---|---|---|
| Fixed asset contributions, beginning of year | $ 5,569 | $ 5,990 |
| Fixed asset contributions received from the Province of Ontario (note 6) | 676 | 676 |
| | 6,245 | 6,666 |
| Transfer to income | 1,014 | 1,097 |
| Fixed asset contributions, end of year | $ 5,231 | $ 5,569 |

See accompanying notes to the consolidated financial statements.

## ONTARIO RESEARCH FOUNDATION

### CONSOLIDATED STATEMENT OF CASH FLOWS

for the year ended December 31, 1987
(with comparative figures for 1986) ($000's)

| | 1987 | 1986 |
|---|---|---|
| Operating Activities | | |
| Earnings | | |
| Income (loss) for the year | $ 595 | $ (10) |
| Charges (credits) to income not involving cash | | |
| Depreciation | 1,773 | 1,918 |
| Loss (gain) on sale of fixed assets | 6 | (37) |
| Gains on sale of investments | (90) | (301) |
| | 2,284 | 1,570 |
| Net change in working capital items | | |
| Accounts receivable | (510) | 601 |
| Prepaid expenses | (351) | (176) |
| Accounts payable and accrued liabilities | 628 | (629) |
| Amounts received in advance for research and other projects | 34 | (965) |
| | 2,085 | 401 |
| Financing Activities | | |
| Fixed asset contributions (note 5) | 676 | 676 |
| Investing Activities | | |
| Purchase of investments | (174) | (158) |
| Proceeds on sale of fixed assets | 14 | 47 |
| Additions to facilities | (233) | (184) |
| Acquisition of apparatus and instruments | (1,651) | (1,185) |
| Acquisition of other equipment | (245) | (235) |
| | (2,289) | (1,715) |
| Increase (decrease) in cash for the year | 472 | (638) |
| Cash, beginning of year | (69) | 569 |
| Cash, end of year | 403 | (69) |
| Consisting of: | | |
| Cash and short-term deposits | 403 | 5 |
| Bank indebtedness | | (74) |
| | $ 403 | $ (69) |

See accompanying notes to the consolidated financial statements.

### NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

December 31, 1987 ($000's)

#### 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

A. Principles of Consolidation

These consolidated financial statements include the accounts of Ontario Research Foundation and its wholly-owned subsidiary, Ordco Technology Limited.

B. Fixed Assets and Depreciation

Fixed assets are stated at cost less accumulated depreciation. Depreciation is provided on a straight-line basis at the following annual rates:

| | |
|---|---|
| Buildings | 3⅓% and 5% |
| Apparatus and instruments | 20% and 33⅓% |
| Other equipment | 6⅔% to 33⅓% |

C. Income Recognition

Professional Services

Professional services revenue is recognized on the basis of the percentage of completion of the work at estimated fees earned or at per diem billing rates depending upon the contractual arrangements. Estimated losses on contracts are recognized when they become known.

Gains on Sale of Investments

Net gains realized on the sale of investments are included in investment income.

D. Pension Plan

The costs of pension benefits earned by employees are determined on an actuarial basis using the projected benefit method. Adjustments to pension costs are amortized to income on a straight-line basis over the expected average remaining service lives of the active employees. Biannual actuarial valuations reflect management's best estimates for investment yields, salary escalation and other factors.

## 2. Pension Accounting

The Ontario Research Foundation maintains a contributory defined benefit final average pension plan which covers virtually all full-time employees.

Effective January 1, 1987 the Ontario Research Foundation prospectively adopted the new recommendations of the Canadian Institute of Chartered Accountants on accounting for pension costs and obligations as described in note 1(D). Previously it treated contributions to the pension fund as pension expense for the year. This change increased net income for 1987 and prepaid expenses at December 31, 1987 by $425,000.

The present value of accrued pension obligations and the pension plan assets at market related values available to meet these obligations as at December 31, 1987 and December 31, 1986 are shown below together with pension expense for the same periods:

| | 1987 | 1986 |
|---|---|---|
| Pension fund assets | $10,132 | $ 9,734 |
| Pension obligations | $ 8,114 | $ 7,598 |
| Pension expense | $ 135 | $ 370 |

## 3. Investments

| | 1987 | 1986 |
|---|---|---|
| Short term investments, at cost | $ 1,036 | $ 794 |
| Bonds and debentures, at amortized cost | 682 | 600 |
| Common and preferred stocks, at cost | 795 | 855 |
| | $ 2,513 | $ 2,249 |
| Quoted market value | $ 2,653 | $ 2,501 |

## 4. Fixed Assets

| | 1987 | | | 1986 |
|---|---|---|---|---|
| | Cost | Accumulated Depreciation | Net Book Value | Net Book Value |
| Land | $ 597 | $ | $ 597 | $ 597 |
| Buildings | 12,963 | 6,441 | 6,522 | 6,812 |
| Apparatus and instruments | 17,128 | 13,226 | 3,902 | 4,244 |
| Other equipment | 3,425 | 2,446 | 979 | 1,025 |
| | $34,113 | $22,113 | $12,000 | $12,678 |

## 5. Capital

Capital consists of the following:

A. Capital Contributions
Capital contributions comprise the original capital sums donated by the Province of Ontario and industry, the income from which is being used to assist in meeting annual expenses in accordance with the terms of the contributions.

B. Fixed Asset Contributions
Fixed asset contributions received from the Province of Ontario and industry provide external resources for acquisition of fixed assets. These contributions are included in capital and are transferred to income over the estimated useful lives of the related assets.

C. Retained Earnings for Acquisition of Equipment and Facilities
Retained earnings provide the internal resources for acquisition of fixed assets. As all earnings are designated for equipment and facilities, the 1986 appropriated and unappropriated surplus balances have been reclassified as retained earnings.

## 6. Contributions from the Province of Ontario

In 1987, Ontario Research Foundation received from the Province of Ontario contributions totalling $4,376,000 of which $3,700,000 has been provided for projects and operations and $676,000 for fixed asset additions.

# BOARD MEMBERS AND OFFICERS, 1987

CHAIRMAN
**J.D. Houlding**
*President*
Polar Gas Project

VICE-CHAIRMAN
**D.A. Chisholm**
*Corporate Director and former Executive Vice-President, Technology and Innovation*
Northern Telecom Ltd.

VICE-CHAIRMAN
**D.M. Green**
*Chairman and Chief Executive Officer*
The Tridon Companies

**J.S. Dewar**
*Corporate Director and former Chairman*
Union Carbide Canada Ltd.

**V.C. German**
*Corporate Director and former President*
Pilkington Glass Ltd.

**R. Halsall**
*President*
Robert Halsall and Associates Ltd.

**R.F. Hawkins**
*Representing the Canadian Manufacturers' Association; President*
Union Drawn Steel Company Ltd.

**H. Hofmann**
*President*
Devtek Corporation

**D.C. MacGregor**
*Medical Director and Vice-President, Clinical Research*
Cordis Corp.

**Mrs. E. Parliament**
*Corporate Secretary and Director of Administration*
Woodbridge Foam Corp.

**D.E. Redgrave**
*Assistant Deputy Minister*
Ontario Ministry of Industry, Trade and Technology

**W. Steven**
*Corporate Director and former Senior Vice-President and Director*
Inco Limited

**R.M. Dillon**
Alafin Consultants Ltd.

**P.A. Lapp**
*President*
Philip A. Lapp Ltd.

**D.J. Watchorn**
*Partner*
Davies, Ward and Beck

During 1988, W. Steven retired from the ORF Board. A former Chairman, his many contributions have been of great value over the years and are most appreciated.

## Executive Committee*

| | |
|---|---|
| **J.D. Houlding** | CHAIRMAN |
| **D.A. Chisholm** | VICE-CHAIRMAN |
| **D.M. Green** | VICE-CHAIRMAN |
| **V.C. German** | MEMBER |
| **Mrs. E. Parliament** | MEMBER |

## Finance Committee

| | |
|---|---|
| **J.S. Dewar** | CHAIRMAN |
| **Mrs. E. Parliament** | MEMBER |
| **R.F. Hawkins** | MEMBER |
| **D.J. Watchorn** | MEMBER |
| **J.D. Houlding** | EX OFFICIO MEMBER |
| **W.P. Midghall** | MEMBER |

## Human Resource Committee

| | |
|---|---|
| **D.A. Chisholm** | CHAIRMAN |
| **H. Hofmann** | MEMBER |
| **J.D. Houlding** | EX OFFICIO MEMBER |

## Nominations Committee

| | |
|---|---|
| **D.A. Chisholm** | CHAIRMAN |
| **R.M. Dillon** | MEMBER |
| **V.C. German** | MEMBER |
| **J.D. Houlding** | EX OFFICIO MEMBER |

*Audit Committee

## Strategy Committee

| | |
|---|---|
| **D.M. Green** | CHAIRMAN |
| **P.A. Lapp** | MEMBER |
| **J.D. Houlding** | EX OFFICIO MEMBER |
| **W.P. Midghall** | EX OFFICIO MEMBER |

## Officers

| | |
|---|---|
| **J.D. Houlding** | CHAIRMAN |
| **D.A. Chisholm** | VICE-CHAIRMAN |
| **D.M. Green** | VICE-CHAIRMAN |
| **W.P Midghall** | PRESIDENT |
| **W.D. Heaslip** | VICE-PRESIDENT MARKETING |
| **R.W. Neville** | VICE-PRESIDENT ADVANCED ENGINEERING AND MANUFACTURING DIVISION |
| **B.T. Porter** | VICE-PRESIDENT FINANCE SECRETARY-TREASURER |

# SCIENTIFIC AND TECHNICAL PAPERS, 1987

The technical meeting arena is another opportunity for our scientists and engineers to simultaneously advance their own base of knowledge and to effect technology transfer, through their professional colleagues, to the industrial, governmental and academic communities.

More than 25 technical papers presented by ORF staff were published during 1987.

1263. **Sanmugasunderam, V.; Lakshmanan, V.I.; Christison, J. and McKim, M.**
Can Microorganisms be Used to Control Nitrate Levels in Mining Process Effluents. *Journal of Hydrometallurgy. Volume 18. 1987. pp. 383-395.*

1264. **Berry, E.E.; Hemmings, R.T. and Golden, D.M.**
Acid-Leached Fly Ash as a Spherical Filler in Polymer Composites. *The Society of the Plastics Industry. 42nd Annual Conference. Composites Institute. Session 25-E. February 2-6, 1987. pp. 1-6.*

1265. **Leung, Raymond W.M.; Pandery, Raj N. and Das, Bejoy S.**
Determination of Polyacrylamides in Coal Washery Effluents by Ultrafiltration/Size-Exclusion Chromatography-Ultraviolet Detection. *Environmental Science and Technology. Volume 21, No. 5, 1987. pp. 476-481.*

1266. **Lo, S.H.; Gibbon, W.M.; Hollingshead, R.S. and Corbin, S.**
The Development and Assessment of Rapidly Solidified Copper-Nickel Alloys for Marine Services. *Materials & Design. Volume 8, No. 1, January/February 1987. pp. 30-34.*

1267. **Lo, S.H. and Hollingshead, R.S.**
Thermal Effect on Rapidly Solidified Cu-10Ni-8Fe Alloy. *Journal of Materials Science Letters. Volume 6, 1987. pp. 441-442.*

1268. **Midghall, Paul.**
Time for Canada to Recognize Changes and Advanced Industrial Materials. *Canadian Chemical News. Volume 39, No. 3, March 1987. pp. 9-12.*

1269. **Piersol, P.**
Technical Issues of PCB Destruction. *1st Annual Hazardous Materials Management Conference of Canada. Toronto, Ontario, September 1987.*

1270. **Piersol, P. and Riley, M.**
Ventilation and Air Quality Monitoring in R-2000 Homes. *ASHRAE Transactions. Volume 93, Part 2, 1987. pp. 1279-1285.*

1271. **Schroeder, W.H.; Dobson, M.; Kane, D.M. and Johnson, N.D.**
Toxic Trace Elements Associated with Airborne Particulate Matter: A Review. *Journal of Air Pollution Control Association. Volume 37, No. 11, November 1987. pp. 1267-1285.*

1272. **Johnson, N.D.; Barton, S.C.; Lane, D.A. and Schroeder, W.H.**
Further GAP Sampler Evaluations of Semi-Volatile Chlorinated Organic Compounds in Ambient Air. *1987 EPA/APCA Symposium on Measurement of Toxic and Related Air Pollutants. Research Triangle Park, May 1987. Proceedings. 1987.*

1273. **Christison, J. and Hayes, W.C.**
Continuous Production of Ethanol Using the Hyperferm Process. *6th Canadian Bioenergy R&D Seminar. Richmond, B.C., February 16-18, 1987. pp. 382-385.*

1274. **Lakshmanan, V.I. and McColl, I.**
Heap Leaching of Gold Ores in Permafrost Conditions. *19th Annual Meeting of the Canadian Mineral Processors. Proceedings. CIMM, Ottawa, 1987.*

1275. **Leidner, J.; Yan, K.L. and Lo, J.**
Advanced Composites: Opportunities and Obstacles. *DRIE Office of Industrial Innovation. Report No. 4/86. 1986.*

1276 **Yan, K.L. and Joyce, I.H.**
Advanced Industrial Materials. *Canadian Chemical News. Volume 39, No. 3, 1987. pp. 10-12.*

1277. **Hemmings, R.T. and Berry, E.E.**
Evaluation of Plastics Filler Applications for Leached Fly Ash. *Electric Power Research Institute Report. EPRI CS-4765/RP2422-11. September 1986.*

1278. **Berry, E.E.; Hemmings, R.T. and Leidner, J.**
Investigation of Some New Spherical Fillers. *Plastics Compounding. November/December 1986. pp. 12-22.*

1279. **Hemmings, R.T.; Berry, E.E.; Cornelius, B.J. and Scheetz, B.E.**
Speciation in Size and Density Fractionated Fly Ash. II. Characterization of Low-Ca, High-Fe Fly Ash. *Materials Research Society. Proceedings. Volume 86: Fly Ash and Coal Conversion By-Products III. 1986. pp. 81-98.*

1280. **Berry, E.E.; Hemmings, R.T. and Golden, D.M.**
Enhanced Resource Recovery by Beneficiation and Direct Acid Leaching of Fly Ash. *Materials Research Society. Proceedings. Volume 86: Fly Ash and Coal Conversion By-Products III. 1986. pp. 365-380.*

1281. **Hemmings, R.T.; Berry, E.E. and Golden, D.M.**
Direct Acid Leaching of Fly Ash: Recovery of Metals and the Use of Residues as Fillers. *8th International Ash Utilization Symposium. Proceedings. Volume 2. Washington, D.C., 1987. Paper 38A-1-15. (EPRI CS-5362 Volume 2).*

1282. **Hemmings, R.T. and Berry, E.E.**
The Role of Non-Crystalline Phases in the Activation of Metallurgical Slags. *International Workshop on Granulated Blast-Furnace Slag in Concrete. Proceedings. Toronto, Ontario, October 22-23, 1987. pp. 439-458.*

1283. **Hemmings, R.T. and Douglas, E.**
Characterization of Granulated Blast Furnace Slag for Portland Cement Replacement. *International Workshop on Granulated Blast-Furnace Slag in Concrete. Proceedings. Toronto, Ontario, October 22-23, 1987. pp. 113-153.*

1284. **Douglas, E.; Mainwaring, P.R.; Van Roode, M. and Hemmings, R.T.**
Determination of Glass Content in Fly Ashes and Blast-Furnace Slags. *Energy, Mines and Resources Canada, CANMET Report 85-6E. 1986.*

1285. **Sibbitt, B.E. and Shaw, M.B.**
Transient Testing of Tempering Valves for Use in SDHW Systems. *Annual Conference of the American Solar Energy Society and the Solar Energy Society of Canada. Proceedings. July 1987. pp. 276-279.*

1286. **Barringer, C.C. and Cane, R.L.D.**
Add-On Heat Pump Optimization. *Canadian Heat Pump Symposium. Proceedings. Emerging Opportunities in Heat Pump Technology. June 1987. pp. 18.1-18.11.*

1287. **McGugan, C.A.; Edwards, P.F. and Riley, M.A.**
Air Flow Reduction During Cold Weather Operation of Residential Heat Recovery Ventilators. *ASHRAE Transactions. Volume 93, Part 2, 1987. pp. 1300-1306.*

1288. **Forrestal, B.J.**
AESF Research Project #71: Factors Which Affect the Success of Metal/Chemical Recovery Installations in the Metal Finishing Industry. *SUR/FIN '87. Proceedings. Chicago, Illinois, July 13-16, 1987.*

1289. **Forrestal, B.J. and McKim, M.P.**
Overview of Peat Sewage Treatment System. *Appropriate Wastewater Management Technologies for Rural Areas under Adverse Conditions. Proceedings. (Based on a Worksbop) held in Halifax, N.S., October 14-15, 1986. Pub. 1987.*

1290. **Laughlin, R.G.W. and Varangu, L.**
Cost-Effective Alternatives to Waste Disposal. *Industrial Waste Management Conference. Proceedings. Toronto, Ontario, November 23-24, 1987. Section F.*

1291. **Varangu, L.**
Industrial Waste Exchange. *1st Annual Hazardous Materials Management Conference of Canada. Proceedings. Toronto, Ontario, September 9-11, 1987. pp. 25-33.*

# ASSISTANCE TO OUTSIDE ORGANIZATIONS

ORF's activities are not limited to performing technical tasks for our clients. More than 50 members of this organization, including officers, directors, managers, scientists and engineers, spent countless hours, many of them outside the normal working day, contributing to the overall advancement of technology through service on various boards and committees of the following 40 organizations during 1987:

*Air Pollution Control Association*

*American Society for Metals*

*American Society for Testing and Materials*

*Association of Municipal Recycling Coordinators*

*Association of Official Analytical Chemists*

*Association of Provincial Research Organizations*

*Canadian Advanced Industrial Materials Forum*

*Canadian Ceramics Society*

*Canadian General Standards Board*

*Canadian Home Builders Association (CHBA)*

*Canadian Institute of Mining and Metallurgy*

*Canadian Journal of Fisheries and Aquatic Sciences*

*Canadian Manufacturers' Association, MAT Forum*

*Canadian Oxygenated Fuels Association*

*Canadian Plastics Institute*

*Canadian Research Management Association*

*Canadian Standards Association*

*Canadian Window and Door Manufacturers Association (CWDMA)*

*Chemical Institute of Canada*

*Durham College Curriculum Committee*

*Environment Canada*

*Flair Homes Energy Demo Project*

*Health and Welfare Canada*

*Insulated Glass Manufacturers Association of Canada (IGMAC)*

*International Metallographic Society*

*International Organization for Standardization (ISO)*

*Materials Research Society*

*McMaster University, Business Advisory Council*

*Metro Toronto Board of Trade*

*National Asbestos Council, Canadian Chapter*

*National Research Council of Canada*

*New Mexico Institute of Mining and Metallurgy*

*Ontario Association of Certified Engineering Technicians and Technologists (OACETT)*

*Ontario Ministry of the Environment (Hazardous Waste Listing/Delisting Advisory Ctte)*

*Purchasing Management Association of Canada*

*Queen's University, Advisory Council on Engineering*

*Recycling Council of Ontario*

*R-2000 Home Program*

*Sheridan Park Association*

*Source Evaluation Society*

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